

Claims

1. A system for neutralizing fluid chemical waste products that result from a chemical production process and are collected from the production line, said system comprising:
 - a pyrolysis/reaction chamber having three or more openings through which one or more plasma torches are inserted, through which one or more inlet conduits pass, and to which an exit conduit is connected;
 - a pre-pyrolysis subsystem comprising a container to collect said waste, a valve to regulate the flow rate, and a pump, which pumps said waste from said container through said inlet conduits;
 - a post-pyrolysis subsystem;
 - sensors that provide information concerning various operating parameters at different locations in said system;
 - a control unit that utilizes information provided by said sensors as well as other information provided to it from other sources in order to allow optimization and automation of the operation of said system; and
 - a display system to provide the operator of said system with information concerning the operation and operating parameters of said system;

wherein, each of said inlet conduits has an atomizer attached at its end pointing into said chamber and each of said atomizers is located such that the jet of small droplets that is formed when said liquid waste

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supplied by said pre-pyrolysis means is pumped through said atomizer effectively contacts at least one of the plasma stream/s created by said plasma torch/es; whereupon the molecules of said waste from which said droplets are composed are dissociated into atoms and/or ions, which move out of the immediate region of said plasma stream and recombine to form a mixture of product gases which exits said chamber through said exit conduit; and wherein said post-pyrolysis subsystem is designed for neutralizing and/or collecting the components comprising the mixture of product gases exiting said chamber through said exit conduit.

2. A system according to claim 1, wherein the fluid chemical waste products can be one or more of the types selected from the following group:
 - liquid;
 - gas; and
 - solid dissolved in a solvent to form a stable solution.
3. A system according to claim 1, wherein the system is located in the vicinity of the end of the production line and the fluid chemical waste products are neutralized immediately after they exit said production line.

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4. A system according to claim 1, wherein the fluid chemical waste products are temporarily stored after they exit the production line and then neutralized.
5. A system according to claim 1, wherein the pyrolysis/reaction chamber is a double-walled chamber, which are cooled by water circulating through the space between said walls.
6. A system according to claim 5, wherein the walls of the chamber are made of stainless steel.
7. A system according to claim 1, wherein the pyrolysis/reaction chamber has a metal wall, which is lined on the inside with refractory material.
8. A system according to claim 1, comprising means controlling the temperature of the plasma stream, said means selected from the following group:
 - adjusting the distance between the electrodes;
 - adjusting the value of the current flowing between the electrodes;
 - and adjusting both the distance and the value of the current flowing between the electrodes.

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9. A system according to claim 8, wherein the adjustment of the current can be carried out while the torch is operating.
10. A system according to claim 1, wherein the energy requirement of the plasma torch/es is determined from the disassociation energies of the molecules of which the waste is comprised.
11. A system according to claim 1, wherein the composition of the gases that comprise the mixture of product gases is calculated using principles of kinetic equilibrium and the results of the calculation are used to design the post-pyrolysis subsystem.
12. A system according to claim 1, wherein the control system has been built to have one or more of the capabilities selected from the following group:
 - to act as an input unit to said system;
 - to store information;
 - to perform computations.
13. A system according to claim 1, wherein a major component of the chemical waste products is comprised of bromine or bromine products.

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14. A system according to claim 13, wherein the chemical waste products result from the production of tetrabromobisphenol A (TBBA).
15. A system according to claim 1, wherein the post-pyrolysis subsystem comprises a particle trap to remove any solid particles from the mixture of product gases.
16. A system according to claim 1, wherein the post-pyrolysis subsystem comprises a radiation cooler to rapidly reduce the temperature of the mixture of product gases.
17. A system according to claim 1, wherein the post-pyrolysis subsystem comprises at least one spray tower in which at least one of the components of the mixture of product gases is dissolved in water.
18. A system according to claim 17, wherein the post-pyrolysis subsystem comprises elements for collecting the solution comprising at least one of the components of the mixture of product gases dissolved in water and recycling it through the spray tower until the concentration of said component in said solution reaches a predetermined value.

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19. A system according to claim 1, wherein the post-pyrolysis subsystem comprises monitoring equipment to measure the composition of the mixture of product gases at selected locations.
20. A system according to claim 1, wherein said system can be transported from location to location.
21. A method for neutralizing fluid chemical waste products that result from a chemical production process and are collected from the production line, said method comprising:
 - providing a system according to claim 1;
 - activating the plasma torch to produce a plasma stream having a predetermined temperature;
 - activating the pre-pyrolysis subsystem to cause said waste to flow through the atomizer thereby creating droplets which effectively contact said plasma stream and dissociating the molecules of said waste into atoms or ions;
 - creating predetermined conditions of temperature and concentration of said atoms and ions such that predetermined chemical reactions take place thereby forming a gaseous mixture of recombination products; and

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- activating the post-pyrolysis means to neutralize at least some of said recombination products so that they may be safely released to the surroundings and/or to collect said recombination products.
22. A method according to claim 21, wherein the fluid chemical waste products can be one or more of the types selected from the following group:
- liquid;
 - gas; and
 - solid dissolved in a solvent to form a stable solution.
23. A method according to claim 21, wherein the system is located in the vicinity of the end of the production line and the fluid chemical waste products are neutralized immediately after they exit said production line.
24. A method according to claim 21, wherein the fluid chemical waste products are temporarily stored after they exit the production line and then neutralized.
25. A method according to claim 21, wherein a major component of the chemical waste products is comprised of bromine or bromine products.

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26. A system according to claim 25, wherein the chemical waste products result from the production of tetrabromobisphenol A (TBBA).